City Document. — No. 19.

CITY OF BOSTON.

ANNUAL REPORT

OF THE

CITY ENGINEER,

FOR THE YEAR

1874.

CITY OF BOSTON.

Office of City Engineer, City Hall,
Boston, Jan. 26, 1875.

To the Honorable City Council: —

In accordance with the requirements of the sixth section of the ordinance relating to the Engineer's Department, the following report of the expenses and operations of the department for the year 1874 is respectfully submitted.

Statement of engineering expenses from January 1st, 1874, to January 1st, 1875: —

Amount expended from department appropriation for 1873–74 .	$6,831 94	
Amount expended from department appropriation for 1874–75 .	18,934 31	
Total expended from department appropriations		$25,766 25
Amount expended from special and other appropriations		9,248 06
Total		$35,014 31

Condition of department appropriation: —

Amount of appropriation for financial year 1874–5	$30,881 00
Amount expended to January 1st, 1875 . .	18,934 31
Unexpended balance January 1st, 1875 . .	$11,946 69

CLASSIFICATION OF EXPENSES FOR ENGINEERING.

City Engineer's Office.

Salaries of City Engineer, assistants, draughtsmen, rodmen, etc.	$22,770 00
Instruments and repairs of same	694 90
Drawing paper and materials	571 70
Stationery, printing stock, etc.	333 56
Reference books, maps and frames	84 50
Printing and advertising	49 98
Travelling expenses, horse-keeping, etc.	912 98
Incidental expenses	340 63
Committee expenses	8 00
Total	$25,766 25

Temporary branch offices at West Roxbury and Brighton. Expenses charged to special appropriation, "Water Works, Wards 13 to 16, and extension to Wards 17 and 19."

West Roxbury Office.

Salaries of assistants, rodmen, etc.	$752 50
Furniture	250 00
Surveying and drawing instruments	204 75
Drawing paper and materials	48 13
Stationery and note books	36 23
Travelling expenses	30 30
Gas fixtures	18 00
Fuel	20 70
Incidental expenses, including care of office and small supplies	38 28
Total	$1,398 89

Brighton Office.

Salaries of assistants, rodmen, etc.	$764 50
Furniture	250 00
Surveying and drawing instruments	42 75
Drawing paper and materials	78 80
Stationery and note-books	36 23
Travelling expenses	11 00
Gas Fixtures	40 24
Fuel	20 70
Incidental expenses, including care of office and small supplies	28 18
Total	$1,272 40

Parker Hill Reservoir.*

Pay-roll and incidentals	$1,866 25

Eastern Avenue and Bridge.*

Pay-roll and incidentals	$1,896 86

Broadway Bridge Foundations.*

Pay-roll and incidentals	$1,106 06

Northampton-street District.*

Pay-roll and incidentals	$896 60

West Boston and Canal Bridges.

Pay-roll and incidentals (one half of this amount was paid by the City of Cambridge)	$811 00

The number of persons employed and paid from the department appropriation, was, on the first of January, 1874 (including the City Engineer), 19. The present number is

* Special appropriations.

25. Average number during the year, 23. Number at present employed in Brighton office, five. In West Roxbury office, four.

The engineering force engaged upon the work pertaining to "additional supply," although under the immediate direction of the City Engineer, is distinct from the force of this department, and is employed and paid by the Water Board.

The large amount and important character of the work performed by this department, during the past year, has necessitated the employment of a considerable number of temporary assistants, and some additions have been made to the permanent force. The system of having all work of any magnitude done under the supervision of competent inspectors has relieved the assistants from that constant attention to the practical details of construction, which formerly occupied so much of their time. The department force has by this means been able to accomplish much more work, and the results obtained have been more satisfactory.

The operations of the department for the past year, together with such general information relating to the various works and structures finished and in progress, as is thought to be of interest, are given in the following statement: —

WATER WORKS.

Lake Cochituate. — At the beginning of the year the water in Lake Cochituate stood 9 feet 8½ inches above the bottom of the conduit; January 29th it had risen to 12 feet 6½ inches and from that date it was allowed to waste over the dam, until February 14th, when it stood at 12 feet 3¼ inches.

During March, April, May and June, it was kept at very near high-water mark.

Waste has been allowed during the following intervals: — from January 29th to February 14th, from February 22d to

March 3d, from April 23d to May 6th, from May 16th to May 28th, and from June 6th to June 10th. The total waste over the dam, for the year, has been 1,145,852,000 gallons, equal to an average daily supply of 3,139,320 gallons.

June 22d the water stood at high-water mark, and since that time it has gradually fallen, standing September 1st, 10 feet, $2\frac{3}{4}$ inches; November 1st, 6 feet, $4\frac{1}{4}$ inches, and on December 31st, 2 feet, $2\frac{1}{4}$ inches above the bottom of the conduit.

In September, a severe drought began, which has lasted till the present time. Early in November it became evident that it would soon be necessary to resort to pumping water from the lake, in order to keep up a sufficient supply to the conduit, and on the 11th of that month the Water Board ordered the pumps and engines to be put in readiness for operation at as early a day as practicable. At this time and during November and a portion of December, the Mystic works were supplying the city proper with from two to two and a half million gallons per day, which, as the consumption for those months was much below the average, enabled the conduit, though running but partially full, to slowly increase the depth of water in Chestnut Hill reservoir.

December 3d, the water was drawn from the conduit to allow stop-planks to be put in at the gate-house. On the evening of that day, the pumps were started, and have continued in constant operation, — with short stoppages for repair, — till the present time (January 26), and have lowered the lake to $6\frac{1}{2}$ inches below the bottom of the conduit.

Conduit. — A thorough examination of the interior of the conduit was made December 3d, by Mr. Wightman and Mr. Cunningham, the latter passing through from the lake to Charles river, and the former from the river to the ventilator near Newton tunnel.

It was found to be in about the same condition as at the

time of the previous examination, April 14th. The springs spoken of in the last report to the Water Board, found within 1,500 feet of the lake, seem to have increased somewhat in strength and volume of flow. During the time the water was drawn off, they brought in large quantities of fine sand. An attempt was made to stop their flow, but it met with little or no success. To make proper repairs in this portion of the conduit, considerable time will be required, as short sections must be dammed off, and the water kept down by bailing or pumping.

Consumption. — The divisions of the city supplied by the Cochituate works are: Boston proper, South Boston, Dorchester, and the greater portion of Roxbury. (A small portion of Roxbury is supplied by the Jamaica Pond Aqueduct Co.) Those supplied from the Mystic Works are Charlestown and East Boston. The West Roxbury and Brighton divisions are not yet provided with a public supply.

The average daily consumption from the Cochituate works for each month of the past year has been as follows: —

	Gallons.		Gallons.
January	16,651,300	July	21,386,200
February	19,103,850	August	20,127,800
March	17,657,300	September	20,022,600
April	15,929,600	October	19,320,900
May	16,731,900	November	14,319,500
June	19,239,750	December	16,407,950

The average daily consumption for the year from the Cochituate works has been 18,074,900 gallons.

During November and December, 57,191,258 gallons were supplied to the city proper from the Mystic works; equivalent to an average daily supply of 1,468,578 gallons in November, and 423,675 gallons in December, and to an average daily supply of 156,690 gallons for the year. The Jamaica Pond Works supply from two to three hundred

thousand gallons per day (say 250,000), to its consumers in Roxbury; hence the average daily consumption for the year, in the four first-named divisions of the city, has been about 18,482,600 gallons.

High Service.

Parker Hill Reservoir. — At the time of the last annual report, the work of building a high level reservoir on Parker Hill had begun, under a contract with Messrs. Tarbell and Hayes. On Nov. 2d it was so far completed that water was let in, and the process of filling commenced. Since that date it has been in daily use. It is now entirely finished, except a small amount of work upon the gate-house and gates, and a small area of bank to be soiled. The work is of very substantial character, and has been very faithfully carried out, under the direction of Mr. Wilbur F. Learned, one of the assistant engineers of this department, by Messrs. Tarbell and Hayes, contractors for the reservoir proper; Messrs. J. W. Colburn and Co., contractors for the gate-house, and the Boston Machine Co., contractors for the gates.

The reservoir will hold 7,200,000 gallons above a plain, $2\frac{1}{2}$ feet above the bottom of the out-flow pipe. The area of the water surface, when at high-water mark, is 1.47 acres, and its elevation is 219 feet above tide marsh level. The elevation of the top of the bank is 222 feet; of the bottom of the out-flow and in-flow pipes, 197.50; of the sills for the stop-planks, 196.25; and of the lower floor of the gate chamber, 196 feet.

Pumps. — The pumping engines have worked very satisfactorily during the past year, and are now in good condition. The average daily quantities of water pumped for each month of 1874 have been as follows: —

	Gallons.		Gallons.
January .	1,097,730	July . . .	1,212,880
February .	1,312,274	August . .	1,206,110
March .	1,160,748	September .	1,283,680
April . .	1,119,266	October . .	1,094,729
May . .	1,171,483	November .	1,649,481
June . .	1,253,333	December .	1,580,163

During November and a part of December the reservoir was filling, which fact accounts, in part, for the large averages of those months.

The average daily quantity pumped for the year has been 1,261,823 gallons, an increase of 23¼ per cent. above the quantity in 1873.

DISTRIBUTING SYSTEM AND PIPE PLANS.

The following extract from the report of Assistant Engineer Dexter Brackett will show the work that has been done in enlarging and extending the pipe system of distribution, etc. : —

"Water Pipes. — During the past year important changes have been made in the distribution of the city proper. The enlargement of the pipes which was commenced in the Burnt District in 1873, has this year been extended through other portions of the city proper.

"The following are among the most important of the changes : —

Tremont street	from	Boylston to School,	enlarged	from	6″ to 16″
Cornhill	"	Court to Devonshire,	"	"	6″ to 12″
Temple place	"	Tremont to Washington,	"	"	4″ to 12″
Sudbury street	"	Court to Portland,	"	"	6″ to 8″
Hanover	"	Union to Court,	"	"	6″ to 12″
Portland	"	Hanover to Merrimack,	"	"	6″ to 8″
Merrimack	"	Causeway to Portland,	"	"	6″ to 12″
Salem	"	Hanover to Charter,	"	"	6″ to 8″

Comm'l	street	from	Prince to Fleet,	enlarged	from	6″	to 12″
North	"	"	Commercial to Fleet,	"	"	6″	to 8″
Beacon	"	"	Somerset to Joy,	"	"	6″	to 12″
Beach	"	"	Federal to Harrison av.	"	"	6″	to 12″
South	"	"	Beach to Lehigh,	"	"	6″	to 12″
Lehigh	"	"	South to Albany,	"	"	6″	to 12″
Albany	"	"	Dover to Way,	"	"	6″	to 12″
"	"	"	Curve to Harvard,	"	"	6″	to 12″

"In South Boston the following changes have been made: —

Dorchester av.,	from	Dorchester	street to Seventh,	enlarged	from	8″	to 12″
Seventh	street	"	" to Dor. av.	"	"	6″	to 12″
Eighth	"	"	" to L street,	"	"	6″	to 12″
Granite	"	"	Second st. to Mt. Wash'n av.	"	"	6″	to 12″

"In the City proper 161 Lowry hydrants have been established, and 113 hydrants of the old pattern abandoned.

"In South Boston 92 Lowry hydrants have been established, and 54 Boston hydrants removed.

"The 24-inch main connecting the force main with Parker Hill reservoir, and the 20-inch high-service main through Pynchon, Tremont, Northampton streets and Columbus avenue to Berkeley street, with the 12 and 16 inch mains from thence to Beacon Hill and South Boston, have all been completed during the past year.

"The 24-inch main in Dorchester has been extended from Upham's corner to the junction of East street and Dorchester avenue.

"During the year about 27 miles of pipe have been laid, and 457 Lowry hydrants established.

"Pipe Plans. — The plans showing the location of the pipes, gates, and hydrants have been corrected as usual.

"Four plans, showing the pipes in South Boston, on a scale of 100 feet to an inch, have been made, so that we now have the entire distribution shown on this scale, with the exception of that of East Boston.

"A large plan, showing the entire distribution of the city, is practically completed.

"Three plans, showing the pipes and hydrants of the city proper, South and East Boston, have been prepared for the use of the Fire Commissioners.

"The plan belonging to the Mystic Water Board, showing the water-pipes, gates, and hydrants in Charlestown, has been corrected."

Survey of West Roxbury and Brighton.

In September surveys to determine the elevation of the streets and houses in West Roxbury and Brighton were commenced, and are now nearly finished. These surveys were authorized by an order of the City Council, passed June 6th, and are made with reference to a pipe system of distribution for these divisions of the city. The work is paid for from a special appropriation for the Water Department, and is done by a corps of temporary assistants.

Flax Pond, and Jamaica Pond Aqueduct Co. — Supply of Water for West Roxbury and Brighton.

On November 21st, an order passed the City Council directing the City Engineer to make surveys and measurements to ascertain the actual amount of water that can be furnished from Flax, Sluice and Cedar ponds.

The measurements were taken during December, and a report was submitted Dec. 21st. (City Doc. No. 110.) The order grew out of an offer of the Flax-pond Water Co. to supply East Boston with water.

On December 21st, another report (City Doc. No. 108) was submitted, in answer to a vote of the Joint Standing Committee on Water, referring "the petitions of John C. Pratt, and G. Winthrop Coffin, that the city would purchase

Jamaica pond, to the City Engineer, with request that he report the facts as to the value of the property in question, and the best method of supplying West Roxbury and Brighton with water."

Additional Supply.

No definite scheme of works for an additional supply of water has yet been adopted, although several reports, with estimates of various schemes for bringing water from a number of sources, have been made and presented to the City Council during the past year.

The reports of Messrs. Kirkwood, Francis, and Horsford, upon the quantity and quality of the water to be obtained from the Mystic valley, together with one from Mr. W. F. Davis, Water Registrar, upon waste of water (City Doc. No. 134, 1873), were presented by the Water Board in January.

On January 29 two orders were passed, one requiring the Joint Standing Committee on Water, to "report upon the possibility and expense of adding to the waters of the Mystic pond a supply sufficient for the use of the city, by connecting said pond with Shawshine, Concord, and Merrimac rivers, or either of them;" the other requiring the committee "to consider the expediency of making a permanent water connection between Farm pond and Lake Cochituate, build a conduit from Lake Cochituate to Chestnut Hill reservoir," etc. On February 16, it was ordered, "that the Joint Standing Committee on Water ascertain, by analysis or otherwise, the purity of the water of Charles river, at the most expedient point of taking the same for the use of the City of Boston;" and on March 23, it was further ordered that the same committee "be requested to have accurate surveys made, under the direction of the City Engineer, to ascertain the water-shed of Mystic pond."

In the latter part of April the committee transmitted to

the City Council the report of the City Engineer upon the above subjects, and presented with it majority and minority reports; also a report of a sub-committee upon mill damages on the Subdury and Charles rivers. (City Doc. No. 38, 1874.)

In May a preliminary report upon the cost of works to bring the waters of Charles river to the city was made to the Committee on Water, by the City Engineer, in obedience to an order passed by City Council May 4.

On June 15 it was ordered "that the Joint Standing Committee on the Water Department ascertain and report whether the present source of our water supply from Lake Cochituate and Mystic lake combined, can be so utilized as to give an adequate water supply to the city in a season of drought," etc.; and on the 29th of the same month it was ordered that the committee "be requested to examine the Charles river, and report in print, upon its availability as a source of supply," etc. The report of the City Engineer upon these subjects was made Oct. 10th (City Doc. No. 85), and was transmitted to the City Council by the committee in the latter part of that month.

In obedience to an order passed June 15, a report (City Doc. No. 102) was presented in December to the City Council by the commission of three physicians, appointed by His Honor the Mayor "to examine and report upon the comparative desirability on sanitary grounds of the Subdury, Mystic, Shawshine and Charles river waters."

In November an order was passed, requesting His Honor the Mayor, to petition the Legislature for the right to take a supply of water from Charles river.

The request of the Water Board, made during the latter part of 1873, that it be authorized to take land and water rights, under the provisions of the Sudbury-river act, was refused by a vote of the Common Council, December 23d; but on December 31st the vote was reconsidered, and the

Board was authorized to take the waters of the river, and also lands for building storage basins, but was prohibited from incurring new liabilities for the construction of a conduit from the river to Chestnut Hill reservoir.

BRIDGES.

The usual annual examination of all the bridges within the city limits, open to street and foot travel, has been made, and the results of this examination respecting the condition of the bridges as to safety and need of renewal or repairs, are given in the following pages.

Several written reports of special examinations of various bridges have been made during the year, and transmitted with such recommendations as were deemed necessary, to the departments having these bridges in charge.

These reports will be found in the appendix.

The following is a list of the bridges inspected. The annexation of a portion of Brookline added two to the list of last year; one (Athens street) has been built during the year, one (Eastern Avenue) is partially completed; and four over railroads in the portion of Charlestown near Somerville, were inadvertently omitted from last year's report.

Those marked with an asterisk are over navigable waters, and are each furnished with a draw.

1st. — Bridges wholly supported by the City.

* Albany street over Roxbury Canal.
Ashland street, Ward 17, over Boston and Providence R. R.
Athens street over N. Y. and N. E. Railroad.
Berkeley street over Boston and Albany Railroad.
Berkeley street over Boston and Providence Railroad.
* Broadway over Fort Point Channel.

Brookline avenue over Muddy River, Ward 15.
* Charles River from Boston to Charlestown.
* Chelsea street from East Boston to Chelsea.
Columbus avenue over Boston and Albany Railroad.
* Commercial point or Tenean, Ward 16.
Dartmouth street over Boston and Albany and Boston and Providence Railroads.
Dorchester street over Old Colony Railroad.
* Dover street over Fort Point Channel.
* Eastern av. over " " "
* Federal street over " " "
Ferdinand street over Boston and Albany Railroad.
Huntington av. over " " " "
* Malden bridge from Charlestown to Everett.
* Meridian street from East Boston to Chelsea.
Milldam over Back Bay Sluices.
* Mount Washington avenue over Fort Point Channel.
Newton street over Boston and Providence Railroad.
Public Garden foot-bridge.
Shawmut avenue over Boston and Albany Railroad.
* Warren bridge from Boston to Charlestown.
Winthrop bridge from Breed's island to Winthrop.

2d. — Bridges of which Boston supports the Part within its Limits.

* Cambridge street from Brighton (Ward 19) to Cambridge.
* Chelsea bridge from Charlestown to Chelsea.
* Essex street from Ward 19 (Brookline) to Cambridge.
* Granite bridge from Dorchester (Ward 16) to Milton.
Longwood avenue from Ward 15 to Brookline.
Mattapan from Ward 16 to Milton.
Milton " " " "
* Neponset from Ward 16 to Quincy.
* North Beacon street from Ward 19 to Watertown.
* North Harvard street " " " Cambridge.

* Prison point from Charlestown to Cambridge.
Spring street from West Roxbury (Ward 17) to Dedham.
* Western avenue from Ward 19 to Cambridge.
* Western avenue " " " Watertown.

3d. — Bridges of which Boston pays a Part of the Cost of Maintenance.

Albany street over Boston and Albany Railroad.
* Canal bridge from Boston to Cambridge.
* West Boston bridge from Boston to Cambridge.

4th. — Bridges supported by Railway Corporations.

1st. — Boston and Albany Railroad.

Harrison avenue.
Market street, Ward 19.
North Beacon street, Ward 19.
Tremont street.
Washington street.

2d. — Boston and Providence Railroad.

Beech street, Ward 17.
Bellevue avenue, Ward 17.
Bellevue street, " "
Canterbury street, Ward 17.
Centre street or Hog bridge, Ward 15.
Centre and Mt. Vernon streets, Ward 17.
Park avenue, Ward 17.

3d. — Boston and Maine Railroad.

Mystic avenue.
Winter Hill road.

4th. — Eastern Railroad.

Mystic avenue.
Winter Hill road.

5th. — New York and New England Railroad.

Broadway.
Dorchester avenue.
Fifth street.
Fourth street.
Harvard street, Ward 16.
Madison " " "
Norfolk " " "
Norfolk " " "
Second street.
Silver street.
Sixth street.
Third street.
Washington street, Ward 16.

6th. — Old Colony Railroad.

Adams street.
Ashmont street, and Dorchester avenue.
Commercial street.
Savin Hill avenue.

RECAPITULATION.

I.	Number wholly supported by Boston	27
II.	Number of which Boston supports the part within its limits	14
III.	Number of which Boston pays a part of the cost of maintenance	3
IV.	Number supported by Railway Corporations: —	
1.	Boston and Albany	5
2.	Boston and Providence	7
3.	Boston and Maine	2
4.	Eastern	2
5.	New York and New England	13
6.	Old Colony	4
	Total number	77

I. — BRIDGES WHOLLY SUPPORTED BY BOSTON.

* Albany st. Bridge (over Roxbury Canal).

The statement in last year's report of the condition of this bridge applies with equal force at the present time. The conclusion of that statement was: "It is now in poor condition, but may be made to do service for a while longer by frequent repairs." The bulkheads at the ends of the bridge have given considerable trouble this winter, and one or both must be rebuilt in the spring.

The cost of repairs on this bridge during the year has been $287.58.

Ashland-st. Bridge (over the Boston and Providence Railroad, Ward 17).

This is a small wooden bridge, 22½ feet in width, and 30 feet span, built in compliance with an order of the Norfolk County Commissioners, dated May 13, 1856. Its abutments, of dry rubble masonry, are within the location lines of the Boston and Providence Railroad, and as that corporation has given notice to the city that it desires the full width of its location at this point, for the purpose of laying additional tracks, a new bridge of greater span will be required.

Plans have been prepared for an iron bridge of 70 feet span, with rubble masonry abutments laid in cement, and, as the necessary orders for its construction have passed the City Council, it is probable the work will be commenced early in the season.

The present bridge is in poor condition, and would require a considerable outlay for repairs, were it not so soon to be removed.

Athens-st. Bridge.

In connection with the laying out of Athens street in South Boston as a public highway, a bridge has been built over the New York and New England Railroad. The railroad at this point is in a cut, the sides of which are sustained by retaining walls, the partial use of which for abutments has made the building of the bridge practicable at a moderate expense.

Plans were made in September for an iron bridge with its abutments; the work was advertised for proposals, and on the 6th of October a contract was made with Colby & Trumbull, the lowest bidders, for doing the work.

The Roxbury stone retaining wall on the easterly side of the railroad was not deemed of sufficient strength for use as an abutment; it was therefore removed, and an abutment built having a granite face with Roxbury stone backing.

The foundation course of this abutment is 9 feet 6 inches wide, and 3 feet thick, the bottom being placed 4 feet below the railroad track. The abutment is 8 feet wide at the base, and 3 feet 9 inches wide at the top, with bridge-seat of granite 4 feet 3 inches wide, and 1 foot 6 inches thick.

The retaining wall on the westerly side, being in better condition than that on the easterly, was used as an abutment after removing and rebuilding about 4 feet in height of the top. This abutment was anchored by means of three $1\frac{1}{2}$ inch rods, to a wall 3 feet 6 inches wide, and 5 feet high, extending across the street 25 feet from the face of the abutment. The bridge-seat course has the same dimensions as that on the easterly abutment. All the stone masonry is laid solid in cement mortar.

The bridge consists of four wrought-iron girders, 22 inches high at the centre, and 17 inches at the ends, and each 31 feet long; they are placed 6 feet 8 inches apart on centres and tied together with $\frac{3}{4}$-inch rods at the top, and $3 \times \frac{1}{2}$

inch bars at the bottom. The roadway timbers are 4 × 14 inches, and 4 × 16 inches, placed 3 feet apart on centres, fitted between the girders, and resting on the lower flange, with furring pieces to conform to the crown of girders. The roadway planking is in two courses, the lower of 4-inch creosoted spruce, the upper of 2-inch spruce.

The bridge is 20 feet wide between the fences, the same width as the street. The roadway is 14 feet, and the sidewalks each 3 feet wide.

Assistant Dexter Brackett has been in charge of the work, which was completed in December, at a total cost of $3,133.50 for the bridge and its abutments.

Berkeley-st. Bridge (over B. & A. Railroad).

Attention has been called in former reports to the light proportions of this structure. The web plates of the trusses are very thin and badly warped, and the sidewalk floor timbers are of light section.

The bridge, however, still continues to do its work, and but little change is noticeable from year to year. It is now apparently in as good order as it was when reported upon last year.

Berkeley-st. Bridge (over B. & P. Railroad).

The fences on this bridge are in bad order, the concrete sidewalk on one side is completely disintegrated, and should be renewed, and the entire bridge needs painting.

No perceptible change has taken place in the southerly abutment, which has been cracked for several years.

* Broadway Bridge.

This bridge has been out of use since May 7th, on account of the rebuilding of the draw and its foundation pier. Ad-

vantage has been taken of the closing of the bridge to travel, to repair the section between the Old Colony Railroad and Foundry street. This section was in very bad condition, owing to the lateral expansion of the roadway, caused, probably, by the freezing of the wood pavement when saturated with water. By this expansion the outer longitudinal beams on each side were so much inclined as to greatly diminish their supporting power, and from the increase of distance between the tops of the beams several of the iron roadway plates had fallen from their places, and the bearing of others had been rendered insecure. The fences were also thrown out of line, and their attachments to the bridge broken in most places.

The several parts of this section have been restored to their normal position, and an attempt has been made to prevent further lateral expansion by means of wrought-iron rods, provided with nuts and strong cast-iron washers. These rods extend across the roadway at short intervals, and pass through 7 × 10 inch longitudinal timbers on each side adjoining the cast-iron curb and also through the curb itself.

The warped condition of the arched girders of the spans over Foundry and Lehigh streets has been mentioned in former reports, but with the exception of the application of temporary braces, nothing has been done to remedy this defect. These girders could be relieved of a large portion of the weight they carry, by the substitution of a burnettized plank flooring for the cast-iron roadway plates. On the Foundry-street span the estimated weight of the plates is about 85,000 lbs; a plank flooring would weigh about 18,000 lbs; the permanent load on each girder could therefore be reduced about 17 tons, and a similar reduction of permanent load could be effected on the Lehigh-street span. Reference lines have been established, for the purpose of noting any further movement of these girders, and in case of any change for the worse it will be necessary to relieve them

from the unnecessary strain caused by the weight of the roadway plates.

Some fitting will be required to make a proper joint between the ends of the fixed spans and the new draw when completed; the gates will need some repairs, and the bridge should be painted before it is again opened for travel.

The sheet piling of the draw pier has been badly eaten by worms, and will probably last but a few years longer. It is so much weakened that a sharp blow, such as it is at any time liable to receive from a vessel, may break in a considerable portion of it. In anticipation of the necessity of soon rebuilding the whole pier, plans have been prepared for this purpose, and a license to do the work obtained from the Harbor Commissioners.

The repairs on the fixed portion of the bridge, made under the direction of this department, have cost $2,932.36 for the year.

Plans and specifications were prepared in the winter and spring for a new foundation pier, and specifications were written for a new draw.

Proposals for building the pier and for a new draw were invited in June. The contract for building the pier was awarded to Messrs. Colby & Trumbull of Lawrence, Mass., for the sum of $51,000.

The bid and designs of the Watson Manufacturing Company of Paterson, N. J., for a new draw were accepted, and a contract made with it to furnish and erect the draw for $26,680.

The old draw, with the exception of the parts reserved for use in the new foundation pier, was sold to Mr. John Cavanagh, of Boston, for $2,200, and was taken down and removed by him.

The new foundation pier is now in a forward state of completion. The novelty of the design and peculiar character of a portion of the work have delayed its completion beyond

the time allowed by the contract. It could, however, hardly be expected that it would progress with the same rapidity as work with which contractors are more familiar, and the many difficulties encountered, although successfully overcome and satisfactory results obtained, have occasioned even more delay than was anticipated.

The construction of the new foundation pier and draw has involved many questions of engineering interest, and a full description of the work will be given in the next annual report, but is deferred at the present time on account of the non-completion of the entire structure.

Brookline-ave. Bridge (over Muddy River).

This is a small bridge, in good order. It has been widened about 8 feet, in connection with the widening of the avenue by filling it to the full width of its location, and has also been replanked.

* Charles-river Bridge (from Boston to Charlestown).

This bridge and the Warren have, by the annexation of Charlestown, come under the same control as the other city bridges, but as the Commissioners had charge of them for a considerable portion of the year, I have requested Mr. Wightman, Assistant City Engineer, who has acted as engineer for the Commissioners on these and on the West Boston and Canal bridges, to report on their condition.

His report will be found in the Appendix.

* Chelsea-st. Bridge (from Chelsea to East Boston).

As this bridge was rebuilt, with the exception of the draw, in 1873, it is in good order.

The draw has been replanked, and slight repairs made upon it. The sampson posts are not plumb, but as the draw is not opened in the winter, no strain of any consequence comes on them, and they will not require attention till spring.

The cost of repairs, made under the direction of this department, has been for the year, $321.00.

Columbus-ave. Bridge (over Boston and Albany Railroad).

A special examination of this bridge has been made by Mr. Manley, with reference to the expediency of increasing the permanent load on the main girders by the laying of a new high-service water-main. His report will be found in the Appendix.

The result of this examination was the building of an independent lattice girder, of sufficient strength to carry safely the water-pipe when filled with water, and a portion of the sidewalk load. To prevent injury to the water-pipe from the vibration of the main bridge under a moving load, the new girder was connected with one of the sidewalk girders only, and all connection with the roadway girders was severed.

The bridge has not been relieved from the weight of unnecessary floor planks, to which attention is called in Mr. Manley's report. It would be improved by scraping and painting the iron work.

The cost of repairs on this bridge, by the Paving Department, was $160.08.

* Commercial Point or Tenean Bridge (Ward 16).

No special repairs have been required on this bridge and it is in fair order. The substructure is built with spruce piles, and will not probably last many years longer.

It would be desirable when it becomes necessary to re-

build the bridge, which consists of little else than a draw, to continue the solid causeway across the channel, leaving only a culvert for the tidal flow. The basin above the bridge is seldom used except as a mooring place for yachts, and will never, in all probability, be used for more important purposes.

Dartmouth-st. Bridge (over Boston and Albany, and Boston and Providence Railroads).

Extensive repairs were made on this structure last year, and, so far as a superficial examination shows, it is now in fair condition. The decay of the wood-work of the trusses doubtless still continues, but as a thorough inspection of it involves considerable work in tearing up flooring and sheathing, it has been postponed until spring. So short a time has elapsed since the new work was finished, it is not probable that any dangerous change has taken place. The auxiliary trusses erected last year should be painted.

Dorchester-st. Bridge (over Old Colony Railroad).

This is an iron bridge, in good order, and will require only ordinary repairs to the wood-work.

* Dover-st. Bridge (over Fort Point Channel).

No material change has been noticeable in this bridge during the year. Repairs to serve temporary purposes have been made, but more extensive ones will be required if the widening and general reconstruction recommended in the last annual report should not be commenced this year.

Broadway bridge being closed, the travel over this bridge has been greatly increased, and the inconvenience resulting from its narrow width has been more than ever apparent.

The cost of repairs for the year, made under the direction of this department, has been $1,993.17.

* Eastern-ave. Bridge.

Several designs, with estimates for building this bridge and its approaches, were presented to the Committee on Streets last spring. The question of grade and location had been determined by the committee of the previous year, after considerable discussion, and the plans submitted were drawn in accordance with the grade and location decided upon, and varied only in details of construction.

Of the plans submitted, the one adopted was, — after receiving the approval of the Harbor Commissioners and the Governor and Council, as provided in the agreement between the State and other contracting parties, under which the bridge is built, — advertised for proposals. Boynton Bros. and Freeman of Boston were the successful bidders, and in July a contract was made with them to build the entire structure, except the iron draw. The contract amounts to about $140,000, the price to be paid being dependent upon the quantities of certain kinds of work required.

Proposals were also invited for an iron draw, designs to be submitted by the bidders under a general specification similar to that for the Broadway, and in August a contract was made with the Phillipsburg Manufacturing Co., of Phillipsburg, N. J., to build and erect a draw for $19,925.00.

The grade of the bridge at the draw had been established at 26 feet above mean low water, with slopes, each side, of 14 inches in 100 feet to a grade of 17 feet.

The plans had been drawn and the contracts made on the basis of this grade; the work of building had already been commenced, and considerable progress made, when the grade was objected to by the Boston Wharf Company. A hearing before the Committee on Streets was requested by the Company and granted, after which the committee voted to recommend to the City Council, the adoption of a lower grade, provided the city should not thereby be subjected to any additional expense beyond the contract price.

As the consent of the Governor and Council, and the Harbor Commissioners, as well as the consent of the City Council, were necessary before any change of the grade could legally be made, work was stopped on all parts of the bridge affected by the proposed change. The Boston Wharf Company were to pay all expenses and damages resulting to the contractors from the stoppage of the work, whether the grade was lowered or not.

The requisite authority has been received and all the necessary papers executed for lowering the grade at the draw to 21 feet above mean low water, with inclines on each side of 18 inches in 100 feet to a grade of 18 feet.

Work has not as yet been resumed on the bridge, but as the grade changes proposed did not affect the foundation pier and draw pier to such an extent as to render a discontinuance of work necessary, the contractors have continued the construction of them until the recent cold weather made it advisable for them to stop.

The amount paid the contractors to January 1st is $60,389.32.

* FEDERAL-ST. BRIDGE (OVER FORT POINT CHANNEL).

This bridge is in good order.

The plan of making the draw in two parts, opening in opposite directions, has proved very successful, and has given general satisfaction. Only ordinary repairs will be needed in the year to come unless from accidents.

The amount paid for repairs under the direction of this department has been . . .	$974 69
Amount expended under other direction . .	802 70
Total	$1,777 39

Ferdinand-st. Bridge (over B. & A. Railroad).

A special report by Mr. Manley, which, with my endorsement, will be found in the Appendix, gives the result of an examination of this bridge.

A short time after that report was written a variety of plans and estimates were made for a new bridge, and for replacing the wooden bulkhead at the side of the street with a retaining wall. The agitation of the question of the extension of Broadway, by which either Castle and Ferdinand streets or Pleasant street would become a portion of this thoroughfare, was commenced about this time, and nothing has been done toward a new bridge. Plans for new wooden sidewalk trusses were made, but they have not been built. The bridge remains as it was at the beginning of the year, with the exception of new floor plank.

Huntington-ave. Bridge (over B. & A. Railroad).

This bridge remains in the state described in the report of last year. The movement in the abutments continues at about the rate of the year before; the greatest movement being $1\frac{1}{4}$ inches in the northerly abutment, and $\frac{5}{8}$ of an inch in the southerly abutment for the year 1874. The iron work is in need of painting.

Malden Bridge (from Charlestown to Everett).

By Chapter 139, Acts of 1874, the care, support and superintendence of this bridge devolves on the city of Boston.

The bridge was built by the Proprietors of Malden bridge in 1787, under authority granted by the Legislature, and was maintained by these proprietors until April 1, 1859, when it was laid out as a public highway by an act of the Legislature. It has since that time until the present year been supported by assessments levied upon the several cities, towns, and cor-

porations benefited by it, and the care and superintendence were in charge of the city of Charlestown.

The bridge, with the exception of the draw, is very old, and is in an unsafe condition. The piles have settled badly, and many of them are rotten and shattered; portions of the flooring are also rotten, and all parts of the bridge are heavily loaded by the mud and gravel covering.

By the settlement of the piles on the centre line of the bridge, water is held as in a trough, after rains and during thaws, and the roadway not being paved is usually covered with a deep layer of mud, or, when the mud dries, of dust, making it one of the worst highways leading from the city.

The street connecting with the bridge has been paved, and the bridge itself should be rebuilt and paved the coming season.

The draw is a new one, built a few years ago by Ross & Lord, and, although very narrow, is in good condition and will require only ordinary repairs.

The cost of repairs for the year has been $864.98.

In view of the poor condition of this bridge, the Chelsea bridge, and Meridian-street draw, it will be necessary to rebuild them as soon as possible, and it is evident that it will greatly inconvenience the travel from the city to the adjacent sections of country on the north, if the three bridges should be closed to travel at one time. I am, therefore, of the opinion that, as neither can be rebuilt without stopping the travel over it, it will be better to rebuild the Malden bridge and the Meridian-street draw this year, and keep Chelsea bridge in use a year longer. My reasons for this opinion are as follows: —

1. Chelsea bridge is a comparatively simple structure, its weak points are open to inspection, and, from its being over flats, exposed at low water for a large portion of its length, all parts of it are easily accessible for repairs, in case of accident. This is not the case with the Meridian-street

draw, nor the Malden bridge, as the structure of both is more complex

2. Chelsea bridge can be temporarily strengthened by cross-bracing the piers with cheap lumber, and by other inexpensive repairs, which will not necessitate closing it to travel, while the dangerous portions of the other bridges cannot be rendered safe without practically rebuilding them.

3. The work on either the Meridian-street draw or Malden bridge, or on both of them, can certainly be done in one season, during which such part of the work of filling at Chelsea bridge as can be accomplished without closing the bridge may be done.

4. Chelsea bridge being supported by two cities, it is desirable that they should agree upon a plan for widening and rebuilding it, and that the work should be done by each city on its own portion at the same time, thereby avoiding closing the bridge but once. These arrangements, and the settlement of the legal complications that will probably arise between the cities and the abutters and horse railway company, will take so much time that it is doubtful whether the work could be commenced in season to complete it this year.

* Meridian-st. Bridge.

The sidewalks on this bridge have been put in good condition; one section has been relaid with brick, and the remainder coated anew with coal tar concrete.

No other repairs of any amount have been required on the fixed portion of the bridge, and it is now in good order.

The draw was reported last year as being in an unsafe condition, and during this year it has been a continual source of expense to the city, delay and annoyance to the public, and anxiety and labor to those having the care of it. It was built in 1856, and has lasted longer than most structures of

its kind. One of the suspension rods suddenly gave way last summer, and but for the fact that the draw had not swung clear of its landings it would probably have been broken in two.

The Committee on Bridges have given orders for the preparation of plans for a new draw.

Preliminary soundings have been made to determine the character of the foundation, but legislative action should be had before the plans can be completed.

The existing openings for vessels are 60 feet wide, the act authorizing the building of the bridge requiring them to be made that width. As these openings are wider by 24 feet than those in the bridges on Charles river, and 15 feet wider than in any other of the city bridges, it would seem to be an unnecessary width, and it is desirable on many accounts to lessen it.

The cost of repairs on the bridge under the direction of this department has been . .	$1,799 92
Cost of repairs under other direction .	319 06
Total	$2,118 98

MILL DAM BRIDGE (OVER BACK BAY SLUICES).

This bridge is in good order.

* MT. WASHINGTON-AVE. BRIDGE (OVER FORT POINT CHANNEL).

Is in good condition, none but ordinary repairs have been made. The draw pier will require attention soon; the piles on its face are too far apart, and passing vessels break and tear off the plank. The piles have been cut so badly, by the continual spiking of plank, that special pains have to be taken to keep them in place.

The cost of repairs made under the direction of this department has been . . .	$712 34
Other repairs have cost	501 81
Total	$1,214 15

Winthrop Bridge (from Breed's Island to Winthrop).

The planking on this bridge was patched late in the fall, and in doing this work it was found that so many of the old planks are decayed at the bearings, it will be necessary to replank the whole bridge early in the spring. A freight of plank can be landed at the bridge, and the work done without closing it to travel.

The cost of repairs has been $229.17.

Newton-st. Bridge (over Boston and Providence Railroad).

The northerly abutment of this bridge, as stated in last year's report, is badly cracked. It is apparently worse than it was a year ago; but as no exact measurements have been taken, the amount of movement is not known.

The bridge is in good order, and no repairs have been required, as it is but little used.

Public Garden Foot Bridge.

This structure is in good condition.

Shawmut-ave. Bridge (over Boston and Albany Railroad).

This bridge is in good order, except that the parapet needs repairing.

* Warren Bridge (from Boston to Charlestown).

Mr. Wightman's report on the condition of this bridge will be found in the Appendix.

II. — BRIDGES OF WHICH BOSTON SUPPORTS THE PART WITHIN ITS LIMITS.

* Cambridge-st. Bridge (from Ward 19 to Cambridge).

This bridge has been replanked during the year, and other repairs of minor importance have been made. It is now in good condition.

The cost of the work upon it, done under the direction of this department, has been $349.24.

* Chelsea Bridge (from Charlestown to Chelsea).

The total length of this structure is 3,633 feet, of which Boston maintains 2,000 feet (stated by mistake in the last report as 2,333 feet), except that the Lynn and Boston Horse Railway Corporation is required to plank one half the width, and to keep in repair the two lines of stringers which carry its track.

As at the date of the last report, this bridge is in an unsafe state, though its condition has been somewhat improved during the year.

The draw has been pretty thoroughly repaired, and is now in good order. A number of the worst piles have been replaced by new ones, and the caps renewed or spliced; the stringers and planking are in good condition. The piles, as a whole, are in a dangerous state of wear and decay, and the cross-bracing is almost entirely gone, leaving the bridge free to sway with a passing load.

As has been before stated, from 1,200 to 1,500 lineal feet

of the pile work may be replaced by solid filling. The Mystic-river corporation, and the Boston and Lowell Railroad corporation have made propositions to the city to fill solid those portions which cross their lands; but the propositions have not been accepted.

The legal rights and obligations of the city, in this structure and its location, are not well defined, and a question has arisen as to the width of location which the city owns across the lands of these corporations and at other points. Until this question is settled, or the rival claims are adjusted, by compromise or otherwise, the Committee on Bridges has not thought it prudent to take any steps towards rebuilding, as when rebuilt the bridge should be considerably widened.

The cost of repairs made, under the direction of this department, has been $1,187.47.

* Essex-st. Bridge (from Ward 19 to Cambridge).

This bridge became the property of the City of Boston in 1874, through the annexation of a portion of the town of Brookline.

It was built by the proprietors of the Cambridge and Brookline Bridge, a company incorporated in 1850. It was rebuilt a few years ago, and the portion to be maintained by the city is in good condition; one leaf of the draw, however, should have a new counter-weight.

* Granite Bridge (from Dorchester to Milton).

This bridge is in fair condition. It has required no repairs during the past year, but should be planked in the spring.

Longwood-ave. Bridge (from Ward 15 to Brookline).

A special report upon the condition of this bridge, and the repairs needed, was made by Mr. Manley, December 20, 1873.

(See report for 1873, page 60.) The work there recommended has been done, and in addition the roadway was replanked. These repairs render the bridge secure for the present, but it must be rebuilt at no distant day.

The cost of repairs was $1,500, one half of which was paid by the town of Brookline.

MATTAPAN BRIDGE (FROM WARD 16 TO MILTON),
and
MILTON BRIDGE (FROM WARD 16 TO MILTON).

These bridges are in good order.

* NEPONSET BRIDGE (FROM WARD 16 TO QUINCY).

Designs for rebuilding and widening that portion of the Neponset bridge, which is maintained by Boston, were finished early in 1874, and it was expected that the work of rebuilding would be done last summer; but an accident to the draw, which necessitated immediate and rather extensive repairs, made it advisable to repair the bridge as well; this was done in such manner that the structure is in fair condition for the traffic of the coming year.

The cost of repairs has been $1,670.23.

* NORTH BEACON-ST. BRIDGE (FROM WARD 19 TO WATERTOWN).

This bridge is in good condition.

* NORTH HARVARD-ST. BRIDGE (FROM WARD 19 TO CAMBRIDGE).

Both the roadway and the draw pier of this bridge have been planked, and a shelter for the draw-tender has been built.

It is now in good order.

The cost of repairs made under the direction of this department has been	$1,017 45
Cost of other repairs	481 49
Total	$1,498 94

* Prison Point Bridge (from Charlestown to Cambridge).

The condition of this bridge is about the same as at the date of the last annual report. The draw-tender's house has been repaired, and a water-pipe has been laid for its supply.

The cost of repairs has been $371.60.

Spring-st. Bridge (from Ward 17 to Dedham).

This bridge is in good condition.

* Western-ave. Bridge (from Ward 19 to Cambridge).

The upper works of this bridge, with the exception of the draw, have been renewed, and a shelter built for the draw-tender. It is now in good order.

The cost of repairs made under the direction of this department has been	$2,403 49
Cost of other repairs	483 15
	$2,886 64

* Western-ave. Bridge (from Ward 19 to Watertown).

This is an old structure, with a badly located draw-way. The town of Watertown has given its portion very thorough repairs during the last season, and the draw pier belonging to Boston has been rebuilt. The draw is in bad condition,

and will need repairs or renewal in the spring, and the roadway of the bridge must be replanked.

The cost of repairs has been $773.52.

III. — BRIDGES OF WHICH BOSTON PAYS A PART OF THE COST OF MAINTENANCE.

Albany-st. Bridge (over Boston and Albany Railroad).

It was stated in last year's report that this structure was soon to be removed to make place for one of longer span, to accommodate improvements in progress by the Boston & Albany Railroad, and that the change would be made at its expense.

Nothing has, however, as yet been done by the corporation, and the bridge and its abutments are in the same condition as last year.

Canal Bridge (from Boston to Cambridge).

West Boston Bridge (from Boston to Cambridge).

These two bridges are in charge of Commissioners. Mr. Wightman's report, in the Appendix, will give all requisite information as to their condition and the proposed or completed improvements.

IV. — BRIDGES SUPPORTED BY RAILWAY CORPORATIONS.

The Appendix to last year's report contained a special report by Mr. Manley, on the condition of the bridges of the Hartford and Erie (New York and New England) Railroad, which required inspection by this department.

During the past year the condition of many of these bridges has been greatly improved. Of six bridges reported unsafe, three have been wholly rebuilt, and the most objec-

tionable portion of one other repaired. Two bridges classed as probably safe, but concerning which doubt existed, on account of the difficulty of proper inspection, have also been rebuilt.

Two bridges still remain in an unsafe condition; the Sixth street and the Norfolk avenue No. 1. These bridges are deficient in strength by reason of their faulty design, independent of any question of decay.

Four bridges, Second street, Third street, Broadway and Fifth street, are old, and the plank and timbers more or less decayed.

All other bridges within the city limits, maintained by railway corporations, and coming under the inspection of this department, are in good or fair condition, and require no special mention in this report.

MISCELLANEOUS WORK AND CONSTRUCTIONS IN 1874.

Northampton-st. District.

A contract for filling this district was made with Phineas E. Gay, of Boston, April 15, 1874. He was to receive $6.40 per square (of eight cubic yards each), for all gravel delivered on the territory, and in addition to this sum $1.00 per square for all filling between grade twelve and such higher grade as might be established or designated on any of the streets, ways or places in the district.

By order of the Joint Special Committee on the district, the City Engineer was directed to measure the banks and furnish estimates of the amount of gravel taken therefrom, and deposited on the district, and also to measure and estimate the amount deposited on the several estates and on the streets and passageways above grade twelve.

The contractor began to deliver gravel July 17, 1874,

and completed his contract Dec. 9, 1874, having delivered during that time 21,293 squares, or 170,344 cubic yards. The bank from which the gravel was taken is located at Springvale, on the New York and New England Railroad, about twelve miles from the district.

A measurement of the banks was made before work was commenced, and every estate, street, and passageway on the district was levelled over. Monthly estimates have been made of the amounts taken from the bank, and the total amount subdivided for purposes of assessment, as ordered by the committee.

Assistant E. W. Howe has had charge of the measurements, and two tallymen were appointed to keep account of the number of car-loads that left the bank, the number received on the district being kept by Mr. L. W. Knight, the superintendent of the district. The total number of car-loads removed from the bank was 39,319. The total number received on the district, as reported by Mr. Knight, 39,008, — a discrepancy of 311 car-loads, which were lost by the upsetting of cars, or used by the contractor for levelling up the track.

Swett-st. Extension.

Plans have been made for the water-ways or bridges over the openings required by the Harbor Commissioners to be left through the solid filling of the extension of this street across the South Bay. These plans have been submitted to the Harbor Commissioners, and a license for their construction granted.

Estimates of the amount of filling required for the street and for raising the railroad to pass over it, also estimates for the railroad bridge and abutments, and for building the water-ways, have been furnished to the Street Commissioners.

Atlantic-ave. Retaining-Wall (near Russia Wharf).

Plans for this wall were prepared during the summer, and a contract made with Daniel Cram, August 25th, 1874, to build it.

The work consists of short sections of wall across the heads of two docks, one on each side of Russia Wharf, and on the line of widening of Atlantic avenue (formerly Broad street). The wall is 23 feet high, 4 feet thick at the top and 15 feet at the base, including a projection of 2 feet of the footing course.

It is built of New Hampshire granite, is well ballasted with oyster-shells and capped with a granite curb carrying a wooden fence with wrought-iron standards. The bottom rests on hard clay 6 feet below mean low water, all soft material having been removed by dredging.

By arrangement with the abutters, the outer line of the wall at the top is 20 inches on their land.

The contract price is $5,350; amount paid to January 1st was $3,623.25.

Change of Location of the Eastern and Boston and Albany Railroads.

By a resolve of the Legislature, approved May 22, 1874, the petition of the Mayor for a change in the location of these railroads in East Boston, to prevent the crossing at grade of important streets, was referred to the Railroad Commissioners, with instructions to consider and report upon the various questions relating to the subject as soon as practicable.

By direction of the Joint Standing Committee on Legislative Matters, surveys and estimates were made by Mr. J. B. Cunningham, an engineer of experience in railroad affairs, to demonstrate the feasibility of the project from an engineer-

ing standpoint, and also to obtain such information as would be of value to the committee in making, on behalf of the city, a proper presentation of the subject to the Railroad Commissioners.

The results of Mr. Cunningham's investigations, with my comments thereon, are embodied in a report to the committee (City Doc. No. 86, 1874).

Seaverns-ave. Retaining-Wall.

Plans and specifications were prepared in June for a retaining-wall of Roxbury stone to be located on the northerly side of Seaverns avenue (Jamaica Plain).

The contract for building it was awarded, June, 1874, to Thomas Dolan, for $1,985.00.

The wall is 150 feet long, of an average height of 8 feet, and provided with a granite cap. It was substantially built under the supervision of an inspector (Mr. J. W. Coburn), and was completed August 6, 1874.

Harrison-ave. Retaining-Wall.

During the fall there was built on the southerly line of Harrison avenue, between Hunneman and Northampton streets, a rubble retaining-wall with granite coping. The contractor, Mr. George Coyle, commenced work Sept. 21, 1874, and the final estimate was made Dec. 11, 1874.

This wall has a foundation of oyster shells, 7 feet wide and 3 feet deep, and is 5 feet wide at the bottom and 6 feet high, with a rough-hammered granite coping 12 × 14 inches. All the masonry is laid solid in cement mortar, and the wall is ballasted in the rear and for a portion of its height on the front with oyster-shells. It is in four sections, measuring together 408 lineal feet; and a wall 300 feet in length, similar in design, built in 1872, but of which this wall is a continuation, was capped with a granite coping by the same contractor.

The contract price for the work was $8.00 per lineal foot, for the new wall, and $1.00 per lineal foot for the coping on the old wall. Mr. Nathan D. Whitman was employed as inspector.

Yarmouth-st. Retaining-Wall.

This wall is located at the end of Yarmouth street adjoining the Boston and Providence Railroad.

A contract for building it was made with Messrs. Clapp and Ballou, Oct. 17, 1874, for the sum of $4,097.00.

The wall is built on piles, alternate rows of which extend into the street from the back of the wall. Each row of piles is girder-capped with two 4 × 12-inch spruce sticks bolted to each pile. The wall is 91 feet long and 9 feet high, and has a 20 × 20-inch granite coping, carrying a tight board-fence 5 feet high supported by iron standards.

The work has been thoroughly done under the supervision of Mr. E. D. Swallow as inspector, and a final estimate upon it was made Dec. 26, 1874.

Army and Navy Monument.

By the terms of the contract with Mr. Martin Milmore for the erection of this monument, the City Engineer is required to make quarterly estimates of the work done and materials furnished in its construction.

The contract was executed June 2, 1871, but none of the materials were delivered at the site of the work until early in October, 1874.

A sub-contract was made Sept. 23, 1874, by Mr. Milmore with Messrs. Johnson & Richmond of this city, for the erection of the monument, and by the terms of this contract the work was to be done to the satisfaction and acceptance of the superintendent of the work and the City Engineer.

By direction of the Committee on the Army and Navy

Monument, an inspector, Mr. E. D. Swallow, was appointed by this department to superintend the work. All the cut stone delivered were set in October.

The first quarterly estimate was made October 31, 1874, the amount paid the contractor being $22,500.

Frequent inquiry is made at this office, with regard to the width of the draw-openings in the bridges over tide-water in this city. I have recently had all of these openings measured, and the results, which may be of value to parties interested, are given in a table in the Appendix.

Respectfully submitted,

JOSEPH P. DAVIS,
City Engineer.

APPENDIX.

TABLE

Showing the widths of openings for vessels in all bridges provided with draws, in the City of Boston.

Name of Bridge.	*Location.*	*Number of Openings.*	*Width.*	
			Feet.	Inches.
Boston & Maine R. R.	Boston to Charlestown	1	36	3
" "	Charlestown	1	36	1
Broadway (Boston side)	Over Fort Point Channel	1	43	11
Cambridge st.	Ward 19 to Cambridge	1	30	2
Canal	Boston to E. Cambridge	1	36	0
Charles River	Boston to Charlestown	1	36	3
Chelsea	Charlestown to Chelsea	1	33	6
Chelsea st. (East Boston side)	East Boston to Chelsea	2	33	4
" (Chelsea side)	" "		34	11
Commercial Point	Ward 16	1	25	7
Dover st	Over Fort Point Channel	1	32	0
Eastern R. R.	Boston to Charlestown	1	35	10
"	Charlestown	1	35	9
Essex st.	Ward 19 to Cambridge	1	31	1
Federal st.	Over Fort Point Channel	1	35	8
Fitchburg R. R.	Boston to Charlestown	1	36	6
" " (for teaming Freight)	" "	1	36	1
Grand Junction R. R.	Ward 19 to Cambridge	1	31	10
" "	East Boston to Chelsea	1	39	4
Granite	Ward 16 to Milton	1	31	0
Granite st.	South Boston	1	34	5
Lowell R. R. (Freight)	Boston to E. Cambridge	1	35	8
" (Passenger)	" "	1	36	0
Malden*	Charlestown to Everett	1	44	3
Meridian st. (East Boston side)	East Boston to Chelsea	2	59	7
" (Chelsea side)	" "		59	0
Mt. Washington ave. (Boston side)	Over Fort Point Channel	2	37	1
" " (So. Boston side)	" "		38	6
Neponset	Ward 16 to Quincy	1	29	7
N. York & N. England R. R. (Boston side)	Over Fort Point Channel	2	41	2
" " (S. Boston side)	" "		41	9
" "	Over South Bay	1	30	0
North Beacon st.	Ward 19 to Watertown	1	30	0
North Harvard st.	Ward 19 to Cambridge	1	32	0
Old Colony R. R.	Over Fort Point Channel	1	32	9
" "	Ward 16 to Quincy	1	30	10
Prison Point	Charlestown to Camb'dge	1	30	6
Warren	Boston to Charlestown	1	35	10
West Boston (Boston side)	Boston to Cambridge	2	30	7
" (Cambridge side)	" "		30	4
Western ave.	Ward 19 to Cambridge	1	31	1
"	Ward 19 to Watertown	1	29	8

APPENDIX.

SPECIAL REPORT ON CHARLESTOWN AND CAMBRIDGE BRIDGES.

OFFICE OF THE CITY ENGINEER,
BOSTON, Jan. 1st, 1875.

JOS. P. DAVIS, *City Engineer:* —

SIR, — I submit the following report on the Charlestown and Cambridge Bridges, in accordance with your request.

The annexation of Charlestown to Boston did not cause any change in the management of the Charles-river and Warren Bridges, until July 13, 1874, when the City Council, by the passage of a new ordinance, placed them under the same control as the other city bridges, and the duties of the Commissioners ceased.

The West Boston and Canal bridges are still in charge of Commissioners, for whom I have continued to act as engineer during the past year.

CHARLES-RIVER BRIDGE.

The extensive repairs required on this bridge, which were stated in detail in my last year's report, have not as yet been made.

The Commissioners obtained the necessary appropriations, but their tenure of office being uncertain, they did not feel

authorized to commence the work. The bridge is, therefore, practically in the same condition as last year, only such repairs as were needed to keep it in running order having been made.

The easterly end of the draw-pier has been strengthened by driving and securely fitting ten new oak bearing and fender piles, and the faces of the draw-way have been replanked where the old planking was broken or torn off.

The draw has been disabled once during the year by the breaking of one of the main trucks, but, owing to the precaution of keeping on hand a duplicate truck, travel over the bridge was interrupted during only a portion of one day.

The reconstruction of the decayed portions of the superstructure and the other improvements needed should be commenced early in the spring; for although the bridge cannot be called unsafe for travel (the substructure and main portions of the superstructure being sound), it is in a discreditable condition for one of the main avenues between the City Proper and Charlestown.

Warren Bridge.

With the exception of the roadway floor-planking, on a portion of the Boston end, which is rotten at the stringer bearings, and the fender-guard on the easterly side of the Charlestown end, which needs new capping and bracing, this bridge is in good condition, and will require only ordinary repairs.

In October two of the main bridge stringers, near the Charlestown end, were found to be unsafe. They had evidently been cracked for some time, as the bridge superintendent had noticed a settlement at this point; but, by the recent passage over them of teams loaded with large stone for the Army and Navy Monument, they had been broken in such a manner as to render their renewal immediately necessary. The bridge was closed to team travel while new

stringers were being put in, and advantage was taken of this closing to make some repairs required on other portions of the superstructure.

Canal Bridge.

During the past year, about 700 feet in length of this bridge has been entirely rebuilt, and the remainder widened so that it is now, with the exception of the draw, of a uniform width of 64 feet from end to end.

All the decayed portions of the old bridge have been renewed, a new fender-guard and draw-pier built, the roadway paved with small granite blocks, and the sidewalks with brick, and both sides of the bridge furnished with gas lamps.

A new wooden, centre-pivot, counterbalanced draw has been constructed, 50 feet in width, and an average length of 129½ feet, and a steam engine and machinery provided for moving it off and on, and for pulling vessels through the draw-way.

Travel over the bridge was suspended for five months, and the work was completed on the first of October, 1874, at a cost of $146,598.22.

The Bridge Commissioners, in their report, say: "The thorough and workmanlike manner in which the whole work has been performed is creditable to the several contractors, and the Commissioners believe that the bridge and its appurtenances are as well adapted for the exigencies of travel as any similar structure leading from the City of Boston."

West Boston Bridge.

The wood pavement in the roadway of this bridge is in bad condition, and will be replaced with granite blocks in the spring.

The present draw is an unsafe structure, but is soon to be removed and a new one substituted of improved construction

and longer span, as the draw-ways are to be made 36 instead of 30 feet in width. In other respects the bridge is in good condition.

Respectfully submitted,

HENRY M. WIGHTMAN,
Assistant City Engineer.

SPECIAL REPORT ON FERDINAND-STREET BRIDGE.

Office of City Engineer, City Hall,
Boston, May 4, 1874.

Joseph P. Davis, Esq., *City Engineer:* —

Sir,— I have examined the bridge on Ferdinand street over the Boston & Albany R. R., and now make the following report: —

The plank covering has been wholly removed from the roadway, and enough from one of the sidewalk trusses to show its construction.

No decay has been found in the wood-work, and the iron-work is in fair condition. The main trusses show no signs of failure that I have discovered. The sidewalk trusseshave settled somewhat, and lean outward considerably, but not more than I should expect them to do immediately after being put in position; if the bridge be covered with plank, I have found no reason why it should not be as strong as it has ever been in the past. There are no *slight* repairs that I can suggest which will do much good toward strengthening it.

The bridge has always shown great vibration under a

heavy load, and even a very light load is sufficient to deflect the floor beams perceptibly. The cause of this is the very small depth of the floor beams compared with their span, and the manner in which they are attached to the main trusses.

I know of no remedy for this vibration except an entirely new set of floor beams, of proper depth, attached to the trusses in a proper manner.

Main Trusses.

The main trusses are compound structures, one element being an arch and tie, the other a truss with parallel flanges connected by a web made of concentric circles of bar iron riveted to each other and to the arch at all intersections. The chords are also connected by vertical tie rods.

The bridge was designed by Mr. Boles, and built by Messrs. G. W. & F. Smith, and was erected in 1863.

The tie of the arched member has about one-fourth the strength of the arch. The only points of attachment to the arch are the rivets in the circular bracing. The lower chord is attached to the bow in such a manner that it may act as a tie, but it is doubtful if the arch adds much strength to the truss.

The parallel chords are about four-tenths of the strength usual in bridges of this span, width and height of truss, and the bracing is of such character that it is difficult, if not impossible, to estimate its strength with certainty; both chords and bracing are of uniform cross-section for the whole length of the truss.

Sidewalk Trusses.

The sidewalk trusses are wooden structures built of 4×4 inches, 2×4 inches, and 1-inch sticks, fastened

with cut nails, and put together in such a manner as to make any calculations of strength out of the question. They have settled 3 or 4 inches below a horizontal line, and as much or more from the perpendicular.

FLOOR BEAMS.

The floor beams are compound structures consisting of 6-inch I-beams, with a wooden beam $3\frac{1}{2} \times 6$ inches on either side, the whole trussed with a 1-inch rod, with two struts about 5 inches deep. They are attached to the main truss in an unusual manner, resting on one flange of one of the two angle irons which make the lower chord, and retained there by straps on every third beam, which pass through the truss and are fastened to the floor beams of the sidewalk; these straps hold the roadway to the trusses firmly.

The truss rods of these beams are attached in such a manner, and the struts are so short, as probably to add no strength to the beam.

A 6-inch I-beam, 25 feet between bearings, is not very stiff with any load; in this case the ends of the beam are firmly attached to the truss, and the truss is shaken from side to side by the vibration of the beam.

The remedy for the vibration is a new set of floor beams. The bridge is now 16 feet above the rails of the railroad, so that no beam can be put lower than at present. The present thickness of the floor of the bridge is insufficient to give the proper depth to floor beams for stiffness, consequently a new set of floor beams involves the raising of the grade of the bridge. If the main trusses could be depended upon, it might be possible to build a beam that would answer without so doing. In any event it would be necessary to raise the trusses in order to attach the floor beams properly.

I have no doubt that the general reputation of the bridge for weakness saves it from many heavy loads, and if a

stronger floor is furnished, two consequences follow: first, heavier loads are to be expected, and, second, the main trusses become the weak point in the bridge, instead of the floor beams, and an accident to a main truss will be a more serious matter than the failure of one or more floor beams.

The sidewalk trusses are of most extraordinary design, and I cannot answer for their strength to any extent whatever.

In conclusion, I repeat that I know of no *slight* repairs that will do much good toward strengthening the bridge, and, in addition, that such repairs as will make it entirely safe for public use will amount practically to building a new bridge.

HENRY MANLEY,
Assistant Engineer in charge of Bridges.

Charles Harris, Esq., *Superintendent of Streets:* —

Dear Sir, — I herewith transmit, with approval of its statements, the report of Mr. Manley upon the condition of the Ferdinand-street bridge.

The design and construction of the parts of this bridge are such that it is impossible to estimate what its actual or safe strength is; but it can be shown that it is not capable of bearing more than a certain weight, and that weight is much less than would be given by a dense crowd. For such a load the main trusses are themselves weak, and the floor girders are inadequate for the support of a concentrated heavy load, such as might be brought upon them by an unusually heavily loaded team. That they have not failed heretofore is undoubtedly due to the stiffness of the floor planks.

While the bridge has not that strength which should be possessed by one in its situation, it has withstood the travel of a number of years without showing signs of failure, or of

deterioration, except such as the same length of time would produce in any structure of the kind; and if it is not to be liable to more severe strains in the future than it has already received, I see no reason why it should not remain serviceable for a number of years longer.

The wooden trusses on the outside of the sidewalks should be replaced, however, by others of stronger form.

As Mr. Manley remarks, there seems to be no practicable way to strengthen the main structure without in effect rebuilding it.

JOSEPH P. DAVIS,
City Engineer.

SPECIAL REPORT ON COLUMBUS-AVENUE BRIDGE.

Office of City Engineer, City Hall,
Boston, June 1, 1874.

Joseph P. Davis, Esq., *City Engineer:* —

Sir, — I have examined Columbus-avenue bridge, over the Boston and Albany Railroad, with reference to its ability to carry a 20-inch water-main in addition to its present duty, and report as follows: —

The bridge was built in 1865 by James Tetlow, of Chelsea, from designs by and under the direction of Clemens Herschel, Esq., of Boston, and was paid for by the Boston Water Power Company. It cost $17,210.00 and came into the possession of the City of Boston, October 28, 1869, when Columbus avenue was laid out as a highway.

The main and sidewalk trusses were designed to carry a

load of 40 lbs. per sq. ft. of bridge surface in addition to the weight of the bridge, which was taken at 35 lbs. per. sq. ft., and it was intended that this whole weight should strain the wrought iron 15,000 lbs. per sq. in.

The bridge was erected substantially in accordance with the design. I have computed the strength of the trusses, and my results show that they have the strength intended by the design, and but little if any in addition, while the weight of the bridge has been greatly increased; — from 35 to about 50 lbs. per sq. ft.

The floor beams are relatively much stronger than the trusses.

The four main trusses are of equal strength, but the two next the sidewalks of course carry less weight than the two others.

ONE MAIN TRUSS IN THE CENTRE,

Designed to carry . .	1,344	lbs. per	running foot.
Actually carries . . .	896	"	" "
Leaving for live load . .	448	"	" "
Or in lbs. per sq. ft. . .	25		

ONE MAIN TRUSS NEXT SIDEWALK,

Designed to carry . .	1,344	lbs. per	running foot.
Actually carries . . .	656	"	" "
Leaving for live load . .	688	"	" "
Or in lbs. per sq. ft. . .	44.4		

A 20-inch pipe full of water weighs 344 lbs. per foot.

The part to be carried by the main truss will be 277 lbs. per running foot, leaving for live load 411 lbs. per running foot; or in lbs. per square foot, $26\frac{1}{2}$. Showing that with the water-pipe the outside trusses would carry more dead weight

than those in the centre, but there would still remain a slightly greater margin for live load.

The sidewalk trusses are relatively somewhat stronger than the main trusses, and the flooring of the sidewalk is stronger than the truss.

When the bridge was built, one sidewalk truss was blown down after being placed in position, and the lattice web was never returned to its perfect shape.

The northeasterly sidewalk carries a 12-inch water pipe in addition to any weight heretofore referred to.

The main roadway has been raised at the centre so as to turn the water toward the ends of the span. In so doing an amount of lumber has been used equal to a thickness of 12 inches over the entire surface. This amount of lumber can be safely reduced one third, or 10 lbs. per sq. ft., and the same results obtained as at present.

The answer to the question concerning the 20-inch water pipe is obvious. No further weight should be put upon the bridge on any pretence whatever, and, furthermore, it should be relieved of the extra weight of plank (amounting to more than twenty tons) that it now carries.

HENRY MANLEY,

Assistant Engineer in charge of Bridges.

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HENRY MANLEY,

Assistant Engineer in charge of Bridges.